

“The Fracture of Metals under repeated Alternations of Stress.”

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(Abstract.)

The paper describes an investigation by means of the microscope of the process by which iron becomes “fatigued” and breaks down when subjected to repeated reversals of stress, as in Wöhler's experiments. It is shown that although the greatest stress is much within the limit of elasticity (as determined by the proportionality of strain to stress in an ordinary tensile test), it produces rupture after many reversals. The first visible effect is the production of slip-bands here and there on individual crystals. These gradually become more numerous: they also become accentuated and broadened and their edges turn rough and burred, apparently as a result of grinding of one surface on the other over the plane in which slip has occurred. At a later stage certain of the slip-bands develop into cracks, whose existence can be demonstrated by repolishing the specimen, when the slip bands which have not opened into cracks are obliterated, but the cracks remain visible as actual fissures. As the process of reversals goes on, the cracks spread from crystal to crystal, and fracture ensues. In the particular material dealt with, Swedish iron, having an elastic limit in tension of about 13 tons per square inch and a breaking strength of 23·6 tons per square inch, it was found that a stress not exceeding 9 tons per square inch, when reversed some millions of times, was sufficient to develop cracks and to bring about the fracture of the piece. Stresses of 8 and even 7 tons per square inch were found to develop slip bands which would probably turn into cracks under a sufficient number of reversals. The paper is illustrated by microphotographs taken at various stages of the destructive process.

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